# STAT 486/686: Computational Finance I: Market Models

Date: Spring 2017
Time: TTh 10:50 am – 12:05 pm
Location: Duncan Hall DCH 1064

## Instructors

Prof. John A. Dobelman
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Office Hours: By appointment.

## Course Website

www.stat.rice.edu/~dobelman (see courses)
We will also be using OWL-Space

## Teaching Assistant (TA)

Mr. Terence Liff
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Duncan Hall 2077: 832-465-6148 (text only)
Office Hours: By appointment

## Every.Sentence.Here.Is.Important™

## Course Text (Required):

Thompson, James R., Williams, Edward E., and Findlay, M. Chapman, (2003). "*Models for Investors in Real World Markets"*. Hoboken, N.J.: John Wiley & Sons. ISBN-10: 047135628X; ISBN-13: 978-0471356288

A. Ilmanen, (2011). Expected Returns, an Investor's Guide to Harvesting Market Rewards, New York: John Wiley and Sons, Inc. ISBN: 978-1-119-99072-7

Benoit B. Mandelbrot and Richard L. Hudson (2004). "*The (Mis)Behavior of Markets: a Fractal View of Financial Turbulence*." New York: Basic Books. ISBN: 0465043550.

### Other Recommended Titles

Benjamin Graham, Jason Zweig (2006): "*The Intelligent Investor: The Definitive Book on Value Investing. A Book of Practical Counsel* (Revised Ed)," New York: Harper Collins.

James O'Shaughnessy. "*What Works on Wall Street, Fourth Edition: The Classic Guide to the Best-Performing Investment Strategies of All Time*". New York: McGraw-Hill, 2012. ISBN: 978-007-162576-0

Lewis, Michael M., "*The Big Short: Inside the Doomsday Machine"*, New York: W.W. Norton, 2010. ISBN: 9780393072235

Peter Bernstein, "*Against the Gods: The Remarkable Story Of Risk'*, New York : John Wiley & Sons, 1996. ISBN 0-471-29563-9

G. Edward Griffin (2009), "*The Creature From Jekyll Island: A Second Look At the Federal Reserve*", 4th ed., Reality Zone, ISBN 13:9780912986395

Benjamin Graham, David Dodd (2008), "*Security Analysis: Sixth Edition*", Foreword by Warren Buffett, McGraw Hill, New York

Schwager, Jack D*., "A Complete Guide to the Futures Markets: Fundamental Analysis, Technical Analysis, Trading, Spreads and Options"*, Wiley Interscience, 1984

Murphy, John J., "*Technical Analysis of the Financial Markets: A Comprehensive Guide to Trading Methods and Applications"*, New York : New York Institute of Finance, 1999. ISBN:0735200661

Derman, Emanuel. "*My Life as a Quant: Reflections on Physics and Finance*." Wiley: Hoboken, N.J. 2004. ISBN: 0471394203

Williams, E.E. and Dobelman, J.A., *Investing for Profit: A Data Based Approach (Revised Edition)*, T.&N.O. Book Company, Chicago, Illinois, 2015. ISBN 978-0-9650737-3-8

Patterson, Scott (2010). "*The Quants: How a New Breed of Math Whizzes Conquered Wall Street and Nearly Destroyed It.*" New York: Crown. ISBN: 9780307453372

Patterson, Scott (2013). "*Dark Pools: The Rise of the Machine Traders and the Rigging of the U.S. Stock Market*." New York: Crown Business. ISBN: 9780307887184

## Course Description

Standard computational finance courses routinely use tools based on the Efficient Market Hypothesis (EMH) and the perceived necessity of closed form mathematical expressions to describe financial markets observables. Extensive data analysis shows that the EMH is seriously flawed as are the tools based upon it. This is a course based on the analysis of market data without pre-conceived assumptions. Computer simulation will be utilized as a means of answering "what if?" sorts of questions. The prerequisites for this course are a good practical background in statistics and its uses and an ability to write model based computer programs (using whatever computer language the student finds appropriate).

## Sponsored Message Regarding Student Responsibility:

The Committee on Examinations and Standing has asked that we reiterate the responsibilities of the student to comply with deadlines affecting their status and standing. Essentially this means that you need to be aware of the deadlines for which you alone are responsible (i.e., not your advisor, etc.). This data is maintained on http://registrar.rice.edu/calendars/.

## Textbook

Students are expected to have purchased their required texts during the first week of class. If the text is available at the "Rice" bookstore, and the student elects to purchase the book elsewhere, and this elsewhere-obtained book is not in hand, the student is nonetheless responsible for all assignments and readings. Rice University is generally not able to provide copies of these texts for your use.

## Undergraduate/Graduate Course Designation

The STAT 686 designation is intended for graduate students duly admitted into a graduate course of study at Rice University. In certain exceptional cases, undergraduates may petition to take the STAT 686 version, but GPA and other criteria will be applied. STAT 686 requires additional coursework and will be evaluated at a graduate level.

## Grading

Grading for this course will consist of homework exercises from the text (20%), "Mini-Projects" (30%), a final project (40%), Class Participation (5%), and a Team Evaluation (5%, consisting of self-, peer- and instructor evaluations). The homeworks, mini-projects and final project are to be completed as team projects. Students taking the graduate-level STAT 686 will have additional assignments, with the same grading breakdown as STAT 486. Note that an "A" average in classwork can be offset by low class and group participation grades!

## Professional Standards - DISREGARDING INSTRUCTIONS IN THESE DOCUMENTS WILL RESULT IN LOSS OF CREDIT!

All assignments, with exception of handwritten math proofs and things of that nature, must be prepared in the form of a professional report. You should be able to take one of your reports/project write ups and present to the management of your employer or advisor. This means you need to organize it with appropriate layout, graphics, citations, etc. Unnecessary printouts of numbers are not acceptable, nor are meaningless digits of precision, etc. The font should be large enough for management to easily read (no less than 10-point font, preferably 12). Additional guidance for professional standards may be found in the documents posted on Owl-Space. You should include a cover page indicating the class, assignment, date submitted, and name of student or group members and group number. In the real world, if your management/customers or clients cannot read the report, or if it is filled with superfluous information, they will just return it to you with a request to resubmit. If you are unlucky, they will just pass you over for someone who does these things better.

You are encouraged to make appointments with the peer consultants at the Center for Written, Oral, and Visual Communication for your assignments in this course. These consultants do not proofread or edit your work, but they will provide feedback on topics such as the organization of your paper or presentation, the coherence of your argument, appropriate sentence structure, and grammatical errors. You can make an appointment at the Center's website: http://cwovc.rice.edu/. The Professional Standards checklist and other grading rubrics are posted on Owl-Space in the Help and Reference section of the resources.

## Originality

Although some assignments are not "pledged", keep in mind that plagiarism is a serious problem, and is especially problematic for the student or researcher. Plagiarism will be treated, for pledged assignments, in accordance with the honor code provisions; and for non-pledged assignments, your paper will be returned for a rewrite with the automatic deduction of one letter grade. By plagiarism we mean "quoting, paraphrasing, or otherwise using another's words or ideas as one's own without properly crediting the source." Unfortunately, with the prevalence of internet sources, it is sometimes easy to inadvertently commit plagiarism. You should consult http://futureowls.rice.edu/futureowls/Honor_Code.asp for guidance on how to avoid this problem.

## Assignment Submission, Lateness and Grading Policy

All assignments must be submitted in class on the date due as hard copy to the instructor or designee. The instructors/TA will not be able to print out e-mailed or online-only assignment submissions. Soft copy postings may be made as of COB the day the assignment is due. Both hard and soft copies of the assignments are required in order to receive credit for the assignment. Late papers will in general not be accepted without a university approved excuse. A 20% penalty for HW turned in by next class may be applied; no credit for submissions later than this, although you might be able to negotiate with the grader. Additional guidance on homework submission and project policies is posted on Owl-Space and is also available here.

## Laboratory

No labs are planned to be conducted this semester.

## Examinations

Exams, if required, are usually open book, calculators, etc., under pledged conditions; NO INTERNET is permitted. No examinations are planned to be given this semester.

## Mini-Projects

Mini-projects will be assigned during the semester in lieu of formal textbook or other research assignments. These are intended to be worked on in groups, and should utilize the efforts and ideas of the whole group for about a 2-week period. These assignments will be posted on Owl-Space. You may pick your own team members, but the size of each team will be limited to an appropriate number (no more than three or four). DO NOT wait until the last minute to begin these mini-projects, you will not be successful.

## Final Project

A final project will be assigned which will be completed in the groups/teams which you have previously established. Sometimes a quantitative case is provided, other times the project may be based on your own research ideas, or on the various case studies included in your textbook. You and your team will select a case/topic, and submit a brief prospectus to the instructor for approval.

## Attendance

Students are expected to attend class. Much material is presented in class which might not otherwise be in texts, notes, etc. Attendance will be reflected in the Class Participation portion of the course grade. Although we plan on keeping the course website up to date, if a student misses a class, then he/she is responsible for keeping up with the course material and finding out if any exams, quizzes, or homeworks have been assigned or scheduled. Similarly, important due date changes might sometimes be made in class to your benefit which might not be immediately posted on Owl-Space.

## Laptops and Wearable/Portable Electronic Devices (PED)

Unless so requested by the instructors, please do not use these devices during class, they are a distraction to other students. Prohibited devices include laptops, earbuds, gaming devices, mp3/music/media players, cell/smart-phones, PDA's, Kindle/e-book readers, tablet computers/readers, Apple watch/i* devices, multi-purpose wrist communicators, cameras, GPS/GIS devices, Google glasses, etc. Hearing aids are acceptable to use in accordance with the last item (disabilities) and procedures herein. From time to time the instructors may ask a student to look something up, but in most cases this is not necessary. If the student requests, such devices may be permitted, if the purpose is clearly articulated in advance. The student will be asked to put away their PED's if they are taken out in class; upon the second request, the student will be dismissed from class.

## Software

It is impossible to perform statistical/quantitative data analysis without some sort of computer software, and it is expected that the student will become proficient with one or more statistical software packages. The most widely used data analysis software in the real world today is Microsoft Excel, and its capabilities are impressive. However, more specialized software is sometimes needed, such as Matlab, R/S-Plus, SAS, Python, SQL, Resampling Stats, SPSS, Stata, StatTools, StatExact, Lisrel, @Risk, Maple, Mathematica, C-Plex, etc. Of these, R and

Python have become the choice of many because of their relative ease of use and low cost (FREE!) Download information for some of these packages is available on the course website(s).

One can also program most statistical procedures in a "high-level" programming language such as Java, C/C#/C++, Fortran, VB, etc., along with specialized add-in routine libraries, but these require a lot of work to code and debug. Additionally, you will find that most corporate employers will not be paying for the nice software that is available for you here on campus. Consequently, to enhance your value to your future employer, we suggest that you become proficient in Excel, R/Python and SQL/SAS. Note that a good word processor will also be required in order to prepare reports and presentations; Microsoft Word, OpenSource, LaTeX, etc., are candidates for use in preparing these documents, although use of LaTeX in the business world is sparse.

We are also bringing to your attention H-Quote (http://www.H-Quotes.com); it is a stock price data downloader, originally developed for Metastock and other stock/futures technical analysis software, but its main strength is allowing the user to perform batch/bulk downloads from finance.yahoo.com. As you no doubt know, finance.yahoo.com has a historical stock price downloading facility, but if you have to get more than a couple of symbols then it is a lot of work. H-Quote will do this very easily. You just setup a stocklist such as the current S&P 500 components and H-Quote will download history for all of the symbols. Alternatively, there also are packages for R which will scrape finance data from various internet data sources

## Data Access

It is impossible to perform quantitative ANYTHING without access to timely and accurate data. We are interested in pricing data, financial data, and in some cases economic data. In an era passed, much of the analysts' time was spent in back rooms pouring over company annual reports and slowly filling in the blanks on the columnar pad. Then the columnar pad was replaced with Visicalc and Lotus spreadsheets. These then turned into Microsoft Excel. And it remains this way today, except the annual reports are in some cases easier to obtain. (Unless you need annual reports very far into the past; unfortunately, it turns out most libraries no longer collect these reports).

A large part in developing your skills as quantitative analysts is to be able to find the data that you need. Fortunately, with the internet things are very easy today. However, "cut and paste" from websites is becoming increasingly more difficult, even with Excel's capability for snatching data via web queries, in part because Excel web query development is not keeping pace with websites' tending to not put data in static html table format[1] .

For example, suppose you are trying to get the components of the United States S&P 500 index; you could get them from finance.yahoo.com (http://finance.yahoo.com/q/cp?s=^GSPC+Components); however, you have to download a page at a time which is a lot of work. To make matters worse, in 2011 Yahoo discontinued its service to provide constituents. To fix this you could get them in bulk from Standard & Poor's (http://www.standardandpoors.com/indices/main/en/us), but you first have to have established a login/password, which takes a few hours.

Fee-based data vendors make data collection easier and more targeted or consistent; unfortunately, the access is expensive ($3,000-$10,000 per month), and no single vendor has everything you need (not even Bloomberg!) Fortunately for the Rice University student, several of

[1] See, for example, http://www.cboe.com/DelayedQuote/QuoteTable.aspx. Enter a symbol, the data will appear but not be accessible via Excel web query because the query is based on static html tables.

the most expensive and useful databases are available, and we will be using them extensively. (WRDS: CRSP and Compustat). We have established a class account for your use, and will provide limited overviews of how to use them, but it is your responsibility to learn how to navigate in the system and to validate the data that you might need to download.

Additionally, the Jesse H. Jones Graduate School of Business (JGSB) is providing us access to its El Paso Corporation Finance Center (EPFC). In the EPFC you will have access to several very expensive data vendors such as ARGUS Valuation. Bloomberg Professional, Capital IQ, FactSet, Morningstar Principia, Palisade @Risk, Reuters 3000Xtra, and S&P Research Insight. Use of these data sources is limited only to your imagination. You will need to attend the overview session and sign the access agreement in order to gain access. We will announce the orientation session on Owl-Space, and in class; for more information also see the website: http://business.rice.edu/facility/el-paso-corporation-finance-center

## Course Content

Topics/chapters include

1. Introduction. Review of STAT 482/682 course.

2 Stock price growth as noisy compound interest.

3. Stock progression using differential equations. A geometric Brownian motion for stocks.

4. Investing in real world markets: Returns and risk profiles.

5. Aggregate economic factors influencing risk. Some events in US financial history. Student Group Mini-Project Class Presentations.

6. International monetary policy and the nature of financial collapse. What is a statistician to do with exogenous factors outside one's control?

7. Black-Scholes and the search for risk-neutrality.

8. Alternative pricing models

9. Portfolio examples. Student Group Mini-Project Class Presentations.

10. Summary. Unsettled (unsettling) questions and conclusions.

11. Ending on a controversial note. More realistic paradigms for investment.

12. Conclusions and Look Ahead. Student Group Final Project Class Presentations.

## Rice Honor Code

Before enrolling in this course, you must understand and agree to abide by the Honor System in place at Rice University which protects the academic integrity of all coursework. All students (including graduate students) at Rice are bound by the Rice Honor Code. The Honor Code is a unique feature at Rice, one that is valued highly, and is of profound importance. New students should familiarize themselves with the Honor Code before starting classes. Honor Code violations are very serious, and can lead to dismissal from the University. Suspected violations will be processed in accordance with (http://honor.rice.edu).

Examinations, if held, are conducted under pledged conditions. Proper recitation and use of the Honor Pledge on examinations will be required to avoid a possible penalty of up to 5% of the test grade. Note that the use of prior years' and other solutions to pledged exercises is considered UNAUTHORIZED AID and is not permitted under the Rice Honor code.

If homework and individual assignments/projects may be worked on with other class members, each student must submit their own work for credit. Homeworks should be submitted by each person, but you should indicate with whom you worked when applicable. No direct copying is allowed. Group projects and assignments may be submitted by the group, per submission requirements above.

## Religious Holidays

Rice University has provided a list of religious holidays that might be observed. If you wish to be excused from class on any of these days which do not coincide with University holidays already on the official academic calendar, you must notify the instructor in writing no later than the second week of class.

## Disabilities

Any student with a documented disability wishing academic adjustments or accommodation is required to speak with the instructor about it during the first two weeks of class. All discussions will remain confidential. Additionally, you must make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 | adarice@rice.edu | x5841) in order to register your disability and to determine the accommodations you need. The instructor cannot be make accommodation without the appropriate letter from Rice DSS. Additional program and documentation requirements and responsibilities are spelled out at http://dss.rice.edu/.

## Changes to Syllabus

Changes to this syllabus may be published from time to time, with notice and explanation given in class and via Owl-Space (if used).

Rev: 1/10/2017